WISIONS of sustainability

8

PREP

Promotion of Resource Efficiency Projects

Sustainable biofuel production and use
Options for greener fuels

IV. Issue 2006



www.wisions.net

WISIONS

Sustainable Development is Possible

WISIONS is an initiative of the Wuppertal Institute for Climate, Environment and Energy, carried out with the support of the Swiss-based foundation Pro-Evolution, to foster practical and sustainable energy projects.

Sustainable development is possible. Numerous innovative and valuable contributions from different countries, fields and institutions have shown that an appropriate reconciliation of economic, ecological and social factors is not unrealistic utopia. We have made a promising start, but the greatest challenge still facing us in the 21st century is to learn how to use the world's resources more efficiently and in an ecologically sound and socially balanced way.

Progress is being made; however, fourteen years after the UN Conference on Environment and Development in Rio de Janeiro, many people, especially in developing countries, still lack access to resources, clean technologies, and education. At the same time, people's level of resource consumption and means of production remains unsustainable.

To meet global challenges like climate change, water scarcity and poverty, it is necessary to foster projects of potential strategic global importance by supporting them so that they can be implemented locally. Examples of good practice need to be actively promoted to a wider audience.

WISIONS promotes good practice in resource efficiency through its publication of relevant successful projects in its Promotion of Resource Efficiency Projects: PREP

WISIONS also provides consulting and support to ensure the potential seen in visions of renewable energy and energy efficiency can become mature projects through its Sustainable Energy Project Support: SEPS

Photo: PixelQuelle.de

Sustainable biofuel production and use
Options for greener fuels

As fossil energy resources are in decline and the need to become less reliant on energy imports is becoming more and more relevant in political discussions, alternative energy sources are needed. Biofuels are one possible replacement for fossil fuels. Although biofuels still cost more than fossil fuels, their share in terms of use is increasing worldwide. The global production of biofuels is now estimated to be about 35 billion litres per year.

Biofuels can make a significant contribution in reducing the dependency on fossil fuel imports, especially in the transport sector. Another advantage of biofuels is their contribution to climate protection: as biofuels are usually considered to be CO_2 neutral, their use helps to reduce greenhouse gas emissions. Fossil fuels, on the other hand, are a major source of CO_2 emissions. In Europe, for example, transport is responsible for about 21 percent of all GHG emissions that contribute to global warming.

Biofuels are usually used for transport fuels, but they are also applicable for electricity and heat generation. In relation to reducing dependency on fossil fuel imports, the use of biofuels as transport fuels is particularly effective; however, from a climate protection point of view the efficiency could be greater if biomass were also used for generating both heat and electricity in CHP plants.

There is a wide range of appropriate biomass sources and a broad mixture of resulting biofuels. Biomass input for biofuel supply often constitutes waste products from some other activity or process, but biomass can also be grown for specific use as a biofuel. Common liquid biofuels of the so-called "first generation" are pure plant oil, biodiesel and ethanol based on sugar and starch crops. Among the "second generation", synthetic biofuels as biomass-to-liquids are currently the subject for wide-ranging discussion. Last but not least biogas is a possible future option.

However, the promising qualities and potential of biofuels also bring an element of risk – the social and environmental dimension of cultivation has to be taken into account and, in particular, plantation areas could become a problem. A new and growing market for biofuels may provide incentives for over-harvesting and the establishment of plantations; the intensity of agricultural land may rise and this would have major impacts on habitats, biodiversity, water supplies and soils.

Photo: PixelQuelle.de

In this brochure, WISIONS focuses on sustainable biofuel production and use. WISIONS presents successfully implemented projects from Ghana, India, Austria and Indonesia, with the intention of further promoting the particular approaches used by these projects. Using a key number of internationally accepted criteria, the main consideration for the selection of the projects was energy and resource efficiency, but social aspects were also of relevance. The assessment of the projects also included the consideration of regional factors acknowledging different needs and potentials.

All projects that fulfilled WISIONS application criteria were independently reviewed, and four of them, with the potential to make a significant impact on global energy and resource efficiency, are published in the following pages. WISIONS is pleased to present good practice examples from ambitious projects which have been successfully implemented on different continents. All of these projects are appropriate within their local context and have been developed to a level which meets WISIONS selection criteria. Although uniquely designed for a particular setting and problem, the projects presented can be adapted to different situations or can provide valuable information from their implementation phase. Links to the illustrated good practice examples shown in the brochure, as well as a couple of other issue-related good practice projects, are available on www.wisions.net.

The selected projects are not intended to represent the only possible courses of action to take in the area of sustainable biofuel production and use but they do demonstrate promising approaches.

The next PREP brochure, following the same objectives, namely to collect, evaluate and promote good practice examples, will highlight the issue of "Renewable energy in the food supply chain".

Photo: PixelQuelle.de

B-BOVID LTD – BUILDING BUSINESS ON VALUES, INTEGRITY AND DIGNITY

Location:
Western Ghana

Project's Aim:
To demonstrate best practice in organic farming, to promote biodiversity products, and to produce and supply vegetable oil

Technical Answer:
Establishment of a company that is based on integrity and dignity

Photo: Fresh fruits of oil palm; B-Bovid

Photos: B-Bovid

B-Bovid is a Ghanaian company whose vision is to become a leading medium-sized provider of biodiversity products. B-Bovid wants to raise the awareness of organic farming and also wants to bring the best science to bear on the needs of decision makers in relation to the links between ecosystems, human development and sustainability. The stated mission and objectives of B-Bovid are to produce and supply high quality biodiversity products such as palm oil, palm kernel oil and other vegetable oils, and to provide services such as cattle and fish farming, for the domestic and export markets. To provide the basic raw materials, the company plans to demonstrate best practice in organic farming on its own plantations, to establish an outgrower scheme and provide the members of this scheme with both high quality planting material and training in modern farming techniques.

B-Bovid intends to make use of large scale marginal lands that are not earmarked for growing food crops or for reforestation in order to plant Jatropha Curcas, which is the most promising biodiesel oil feedstock. Currently, the company owns a 200 acre oil palm plantation and has started to build a vegetable oil processing factory.

BENEFITS

B-Bovid is deeply concerned with the social conditions of its local communities. Since organic farming is more labour intensive than farming by traditional methods, B-Bovid intends to offer greater job opportunities to unemployed women and young people. Almost all its current employees come from the surrounding communities and are paid more than the minimum daily wage stipulated by the government.

B-Bovid is in the process of constructing access roads and access to water supply systems for farms. This will benefit around 25 community farmers in

the area and make it easier for them to transport their products to the nearby markets.

B-Bovid also contributed to the building of the local primary school in one of the communities and has already started education for other small scale farmers. These farmers are trained to balance agriculture and nature in the use of land and resources for sustainable wealth creation, healthy living, poverty reduction and sustainable development.

SUSTAINABILITY

Empty oil palm fruit bunches (EFB) are used as fertiliser. These EFB are collected from the local farmers and other major oil mill factories, who would, otherwise, simply throw them away. Apart from providing nutrients to the palm via a slow process, EFB as an organic mulch is known to improve the structure and moisture retention ability of the soil as well as to stimulate root growth for better exploitation of nutrients and water. Its mulching effect would minimise leaching and soil erosion problems, especially on steep lands under intense rainfall.

The use of EFB at 37.5 t/ha per year in oil palm fields has been shown to increase the fresh fruit bunch (FFB) yield significantly and to improve soil exchangeable potassium, calcium, magnesium, and pH level. Other by-products of palm oil production are palm kernel cake (PKC), palm oil sludge (POS) and palm pressed fibre (PPF). These are all residues left behind after the extraction of oil from the kernels of the palm fruits. These products are now well entrenched as a major feed ingredient for ruminants.

The oil palm plantation will be intercropped with, for example, Theumatin Cocous, which is a dwarf plant with a thick vegetative cover that can help check the growth of weeds and preserve soil moisture. More importantly, the Theumatin Cocous plant is potentially a very high income earner as it is known to have a sap that is even sweeter than sugar cane and sugar beet. Scientific studies which have been conducted point to the possibility of this crop replacing sugar beet in the future..

TECHNOLOGY

The project involves the establishment of a vegetable oil processing factory near Takoradi, the regional capital of the Western Region of Ghana, as an upward linkage to the company's farming activities in the this region. Construction of the necessary buildings has already begun.

The main raw materials will be fresh oil palm fruits and palm kernel, about 60 percent of which will be supplied from the company's own plantations. The rest will be bought from the members of an outgrower scheme comprising many smallholder farmers.

Photo: One of the female staff carrying harvested fresh palm fruits; B-Bovid

FINANCIAL ISSUES

As of August 2006, the estimated capital base of the company stood at US$ 680,000, comprising the following: 450 acres of farmland, 200 acres planted with oil palm (two and a half years old), one delivery truck, two tractors, 10 acres of land for a company factory (partly constructed) and an additional 50 acres of land for fish farming. The company started operating in 2004; however, the oil palm needs three to four years of growth before it can be cultivated. The existing farm has oil palm trees of between one and three years old, which suggests that fruit bearing should commence relatively soon.

OBSTACLES

The most significant obstacle at this stage of the project is a financial one. So far, B-Bovid has financed itself using personal assets and savings. B-Bovid is, therefore, seeking funding in the form of grants, soft loans or individual investment; in the form of partnership for expansion of the company activities; or by way of procuring machines or construction of feeder roads that will also serve the interests of community farmers in the area. B-Bovid will also appreciate any technical assistance and expertise.

REPLICABILITY

The global market for biological products and biofuel has changed substantially. However, B-Bovid wants to create multiple streams of revenue, ensuring that these products do reach the market. They incorporate a socioeconomic and sustainable development component that very few companies consider. Therefore, the benefits of this project might encourage the development of other similar projects.

CONTACT

B-Bovid
Mr. Issa Ouedraogo
e-mail: issaoued@yahoo.com

Village-scale biodiesel-fuelled energy system

Location:
Orissa, India

Project's Aim:
To provide running water in non-grid villages using locally produced biodiesel

Technical Answer:
Establishment of a biodiesel-based water pumping programme

Photo: Pedal-driven Biodiesel Reactor; CT_xGreEn

The organisations CT_xGreEn (Canada) and Gram Vikas (India) are working together to create a biodiesel-based water pumping programme in four village communities in the region of Orissa, India. The project's objective is to provide the communities with water supply and sanitation services by means of an energy system based on renewable resources, which also helps to create local economic opportunities.

Underutilised forest seeds will be collected and native local oil-bearing crops will be grown in order to create a sustainable plant oil source. The vegetable oil can then be extracted and used as feedstock for conversion into biodiesel using reagents/catalysts. The biodiesel will then fuel pump-sets and small-scale power generation sets.

Two installations have already been completed; in Kinchlingi and in the twin villages of Kandhabanta-Talataila the villagers are producing biodiesel from vegetable oil via the process of transesterification using pedal-powered machines. Water pumping fuelled by biodiesel has been in use since May 2004 and biodiesel-fuelled power generation since July 2005.

Photo: CT_xGreEn

BENEFITS

Three of the non-grid villages within the target region now have access to a piped water supply. A further benefit will be the extension of the biodiesel energy system to provide electricity in rural areas, which will commence once the sustainability of the project has been proven for water pumping.

Additional benefits include new livelihood opportunities for the villagers, conservation of indigenous forest trees, cultivation of under-utilised oilseeds in fallow land, and enhanced skills within the local community to operate and manage the biodiesel-based energy system. The project operates according to the

principle that the technology used can, and will, lead to land regeneration.

SUSTAINABILITY

The simplicity of the pedal-powered equipment, together with rigorous operating procedures and partnerships with diesel equipment suppliers, has contributed to the project's success. The technology is presently based in self-help groups, which are run by women and act as savings and credit organisations geared toward activities that generate additional income. A core team of local staff members is being created to support the operational training at village level as well as to train maintenance personnel.

The strategy for the future of the project foresees extending the operations of the pilot plant into a resource centre for biofuel-based livelihood strategies. Later, it could be expanded to offer action-oriented research support to field NGOs and to facilitate the installation and commissioning of new biodiesel units including South-North training sessions and knowledge exchanges, micro-energy research and development, and further collaborative partnerships.

TECHNOLOGY

Biodiesel-fuelled pump sets (3.5-5 HP) and small scale power generation sets (2-3kW) are being structured as a closed-loop package. Vegetable oil extracted from locally grown (and native) oil-bearing crops serves as feedstock for conversion into biodiesel. Alcohol (methanol or ethanol) and lye (sodium or potassium hydroxide) are the reagents/catalysts required to convert vegetable oil into biodiesel. Alcohol and lye are both currently being purchased, but in the near future these will be produced from local biomass.

Photo: Hands-on training; CT_xGreEn

FINANCIAL ISSUES

The core funding for the energy systems (pilot plants plus four village units) was provided by WBDM (World Bank Development Marketplace) in 2003, amounting to US$ 230,000. The water supply systems in three villages were built through bilateral funding (Rs. 202,200) with the village communities contributing the remaining 40 percent of the infrastructure cost. The Swiss Agency for Development Cooperation-Intercooperation (SDC-IC) funded a study on legal challenges (Rs. 190,000).

Support in the community is provided by Gram Vikas. The University of Waterloo and The Working Centre of Kitchener, Canada, have been partners at various stages. The International Development Research Centre Canada, which provided C$ 20,000, and the Social Sciences Humanities Research Canada have recently funded a doctoral research project.

OBSTACLES

The main challenge for the project was to communicate the complexity of managing a renewable energy system to the local communities. Most obstacles were overcome by involving the community in the early stages in technology development and by training barefoot technicians. Developing the pilot plant as a nodal centre for raw material procurement and final product testing, establishing standard operating practices in all installations, working with local equipment suppliers for servicing diesel engines and setting up an efficient information retrieval system are all measures that have helped reduce bureaucratic and technical hurdles.

REPLICABILITY

Training the local youth to provide technology support to the women's groups that operate and manage the biodiesel units in the villages has begun on a small scale. The goal is to increase the number of trained barefoot biodiesel technicians and for them to act as ambassadors for replication in other villages. The pilot plant on the Gram Vikas campus was set up in February 2004 for the design, development and testing of machines and processes, and to train villagers. Performance monitoring of diesel pump sets and gensets are ongoing, along with exploratory discussions with engine manufacturers to ensure warranty coverage.

CONTACT

CT_xGreEn (Community-based Technologies Exchange fostering Green Energy Partnerships)
Mr. Ramani Sankaranarayanan PhD;
Ms. Geeta Vaidyanathan
e-mail: ramanisan@yahoo.com
URL: www.theworkingcentre.org/wscd/ctx/ctx.html

City of Graz: biodiesel-fuelled public buses

Location:
Graz, Austria

Project's Aim:
To reduce exhaust and emissions from city buses, to collect and recycle waste vegetable oil

Technical Answer:
Conversion of the city's public buses to biodiesel

Photo: Ecodrive-Bus; City of Graz

In an average year the Grazer Verkehrsbetriebe (GVB), the Graz municipal public transport company, transports 98.2 million passengers in 150 buses, covering a distance of 8.5 million kilometres, consuming 3.8 million litres of diesel and producing significant levels of emissions.

With the slogan "from the frying pan into the tank", the "Ökodrive" (i.e. Ecodrive) programme was born in 1999. "Ökodrive" is the only project that provides a sustainable cycle turning waste vegetable oil (WVO) from harmful waste into a valuable raw material, resulting in biodiesel, which can be used as a renewable, low-emission fuel for the operation of buses in the public transport fleet.

BENEFITS

In 2004, 280,000 kg of waste oil was collected from restaurants and 75,000 kg was collected from private households to be converted to biodiesel. This represents 70 percent and 17 percent, respectively, of the estimated total capacity from these two sources. This used oil is not only turned into a valuable raw material that produces biodiesel, but eliminating the used oil from its previous usage cycles also has dramatic benefits. The oil, which is otherwise difficult to dispose of, is prevented from re-entering the food chain (e.g. in the form of animal feed or margarine) which, in turn, stops it from causing the associated negative health consequences. In addition, eliminating used oil from the waste treatment process lowers the maintenance costs of municipal purification plants and also increases their capacity. Finally, the processes necessary to collect and convert the waste oil create valuable jobs in the region.

SUSTAINABILITY

Graz has been collecting used cooking oil and recycling it for 16 years in increasingly large quantities. The product was first used to create soap, and now biodiesel.

Between 2002 and 2006 the biodiesel initiative was supported by the EU programme CIVITAS/ TRENDSETTER. Today, the entire bus fleet of the Graz public transport company (GVB) has been converted to biodiesel.

Converting the 220 taxis of the largest fleet, the 878 City Funk GmbH, to biodiesel is the next step. The use of fossil fuels causes emissions that are harmful to the environment. The local government, therefore, undertook measures to reduce private car usage, for example by limiting free parking spaces in the city. Taxis are seen as a means of transport that complements the public transport network.

A biodiesel service station was conveniently constructed next to the headquarters of 878 City Funk GmbH, making it unnecessary to drive long distances to obtain biodiesel. The biodiesel station is also open to the general public. By 2005, approximately 65 taxis had been converted to biodiesel.

TECHNOLOGY

In order to investigate the suitability of biodiesel as a fuel for operating conventional diesel vehicles, the city of Graz began the project in 1994 with two buses from the municipal public transport service.

Waste oil from private households and 250 restaurants is collected and recycled into biodiesel. This oil is then delivered to SEEG (Südsteirische Energie- und Eiweißerzeugungsgenossenschaft) located in Mureck, South Styria, as valuable raw material for the production of biodiesel. SEEG is a company that converts used cooking oil into biodiesel. The technology for the conversion of waste vegetable oil to biodiesel was developed by the University of Graz in cooperation with the Technical University of Graz and Biodiesel International (BDI), the knowledge leader in this field.

Photo: Truck for collecting used cooking oil in private households; City of Graz

Using research from the Technical University of Graz, particle filters have been successfully implemented in the bus fleet. As part of the EU programme "Life/Kapa GS", most of the buses will now receive particle filters to reduce exhaust levels, thereby increasing the city's attractiveness.

FINANCIAL ISSUES

Local politicians, as well as the GVB, are pro-environment and they sponsored the 100% conversion of the bus fleet. Support was also forthcoming from the EU to promote a sustainable transport future in Europe in the form of several EU programmes (Civitas/Trendsetter) which supported the projects financially.

Due to a contract between the SEEG and Eco-Service concerning the payment for the collected waste oil, the project's running costs are low, requiring only a minimal level of support from the municipality. Other systems also derive benefit from the project, such as the sewage system and wastewater treatment plant, where about € 30,000 has been saved on maintenance due to the removal of waste oil from this loop. The biodiesel buses have consumption rates that are between 5 percent and 7 percent higher than those fuelled by fossil fuels, but the price of the biodiesel is lower.

An innovative financing plan, based on a special leasing model for buses to include maintenance, allows for quick renewal of the fleet and provides customer-friendly buses that are modified for the disabled.

OBSTACLES

Due to technical problems that arose during the initial phase of the Taxifleet project, two biodiesel experts, from the chemistry department of the Karl Franzens University of Graz and the Institute for Internal Combustion Engines and Thermodynamics at the Technical University of Graz, were recruited. With their help, the problems were solved and the project was a success.

REPLICABILITY

Based on the experience of Ökodrive, the model could be applied universally. An essential prerequisite would be to structure the project in the same way as in Graz. Within Europe, the transferability to similar types of companies would be easily achievable. All measures that have been implemented could easily be transferred to other companies working in similar areas. Many other cities in Europe have already asked for detailed information on this sustainable project and intend to adopt this system, as waste oil is also a problem in these other cities.

CONTACT

City of Graz
Dipl.-Ing. Gerhard Ablasser
e-mail: gerhard.ablasser@stadt.graz.at
URLs: www.trendsetter-graz.at
www.trendsetter-europe.org
www.civitas-initiative.org
www.graz.at

Bioethanol Plant For Gasohol Project by Medco Energi — one solution for the fast growing fuel need in the transportation sector in Indonesia

Location:
Kotabumi, Lampung Province, Sumatra Island, Indonesia

Project's Aim:
To find a solution for Indonesia's fast growing need for fuel

Technical Answer:
Development of Indonesia's first multi-feedstock bioethanol production plant

Photo: Medco-sponsored nursery for a high-yielding hybrid from cross-variety cassava plants; Medco Energi

The government of Indonesia recently declared its intent to support the development of alternative energy sources, including biofuels such as bioethanol and biodiesel. As the basis for such development, the Indonesian Ministry of Energy & Mineral Resources has, at many energy forums, made a public commitment to issuing national blueprints for both bioethanol and biodiesel.

In 2004, the total Indonesian consumption of petroleum-based fuels was 60.06 million kilolitres (KL), while total production from the existing refineries in Indonesia in 2005 was only 44.9 million KL. The rest had to be imported.

In order to redress this situation, Medco Energi is committed to making extensive efforts in developing bioethanol and in initiating its entry into the market by constructing Indonesia's first multi-feedstock bioethanol production plant with the capability of producing ethanol from cassava-derived starch and from sugarcane molasses.

Indonesia is still struggling to overcome an economic crisis following both the monetary crisis of 1997 and various natural disasters. Now it also faces an energy crisis. Developing alternative energy sources to oil is, therefore, one of the major concerns of the Indonesian government.

BENEFITS

The core aim of the project is profit-oriented; however, there are multiple benefits on different levels. The project strives to reduce subsidies for fuel, to foster a cleaner environment and to provide green energy. It also aims to reduce greenhouse gas emissions, and plans are in place to carry out a CDM (Clean Development Mechanism) project.

At local level, farmers are already benefiting directly from this project, fulfilling one of the main goals of the project: to create jobs and to reduce poverty.

SUSTAINABILITY

Medco Energi buys cassava and molasses from local farmers within a radius of 40 km to feed the ethanol plant. Farmers receive assistance from Medco Energi to improve productivity and to increase the starch content of their crop. A CSR programme covers knowledge-sharing on cultivation techniques to plant a high-yielding cassava variety (80–100 tonnes/ha), on planting schedules, on logistics support and on working capital. This assistance programme was started in July 2005 for a one year period. A continuous dialogue with the farmers involved contributes to the success of the project.

No additional land is needed for planting, as Medco Energi also has – in addition to supply agreements with farmers – a Memorandum of Understanding with a large state-owned sugar company from which it receives a sufficient amount of sugarcane.

Photo: 13,500 hectares newly generated cross-variety cassava transplants; Medco Energi

Photo: Harvesting result after 12-months; Medco Energi

To minimise ecological risks of waste from the bioethanol process, water treatments are performed. In addition, the use of chemical fertilisers is very limited, mostly dung is used.

TECHNOLOGY

Medco Energi started by devoting extensive efforts to the development of bioethanol and constructed Indonesia's first multi-feedstock bioethanol production plant with the capability of producing ethanol from cassava-derived starch and from sugarcane molasses. Biogas produced by the waste water treatment facility will be used in this plant to optimise the overall energy efficiency. Initially, 180 KL of industrial-grade ethanol will be produced daily by end of 2007 and the intention is to produce fuel-grade ethanol as the market grows.

The technology used is from India and has proved to be successful. It does not lead to corrosion in the vehicle.

FINANCIAL ISSUES

The total level of financial investment is more than 46 million US dollars. This ethanol project will become the largest independent ethanol plant in Indonesia. When the market demand grows, Medco Energi will scale up this facility and produce fuel-grade ethanol (99.999%).

OBSTACLES

The main obstacle lay in convincing farmers to sell cassava directly to Medco Energi, as many of them were afraid of obtaining a lower price for their crop than they would receive from the tapioca factory (powder cassava for meals). Although Medco Energi did not offer the farmers a lower price, the company nevertheless decided to circumvent this problem by also working directly with the tapioca factory to obtain the necessary raw materials.

Photo: 2-month old high-yielding cross-variety cassava plant ready for field transplanting; Medco Energi

REPLICABILITY

In light of Indonesia's need for energy of 5 percent biogasoline, more than 16 additional bioethanol plants with the same capacity of 180 KL/day are needed. This project is a good example and could be replicated in other areas of the country.

CONTACT

PT Medco Energi Internasional Tbk – Institutional Relation Support (IRS) Lead
Mr. Erwin S. Sadirsan
e-mail: erwin@medcogroup.co.id
URL: www.medcoenergi.com

MEDCOENERGI

Contact us:

More information about WISIONS, application criteria for PREP and SEPS, as well as prior PREP-issues are available at

www.wisions.net

Wuppertal Institute
for Climate, Environment and Energy
Doeppersberg 19
42103 Wuppertal
Germany

e-mail: info@wisions.net
Phone: + 49 (0) 202 . 24 92 252

Science Centre North Rhine-Westphalia
Institute of Work and Technology

Institute for Culture Studies
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I. Issue 2004	Resource Efficient Construction
II. Issue 2004	Water and Energy – Precious Resources
I. Issue 2005	Sustainable Transport – Solutions for Growing Demand
II. Issue 2005	Sustainable Tourism – Combining Holidays with Local Needs
I. Issue 2006	Microfinance and Renewable Energy – Investing in a Sustainable Future
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III. Issue 2006	Corporate Energy and Material Eficiency ... Makes Good Business Sense

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